

WHAT IS CLAIMED IS:

1. An ink-jet recording head comprising:
 - a plurality of nozzles for ejecting an ink;
 - a plurality of individual flow channels filled with the ink and connected to the plurality of nozzles;
 - a substrate constituting a part of an inner wall of the plurality of individual flow channels;
 - a Ta-Si-O ternary alloy thin film resistive element which is provided on the substrate to be disposed in the vicinity of the plurality of nozzles in the plurality of individual flow channels and has a self-oxide film at least on a surface in contact with the ink; and
 - a driving unit that generates heat energy for ejecting the ink from the plurality of nozzles with the Ta-Si-O ternary alloy thin film resistive element by applying electricity on the Ta-Si-O ternary alloy thin film resistive element,

the ink filled in the plurality of individual flow channels in the vicinity of the plurality of nozzles being ejected as ink droplets from the plurality of nozzles through expansion of bubbles formed in the ink with heat energy from the Ta-Si-O ternary alloy thin film resistive element, and the bubbles formed in the plurality of individual flow channels being connected to atmospheric air through the plurality of nozzles.
2. The ink-jet recording head as claimed in claim 1, wherein, upon ejecting the ink in the plurality of individual flow channels as ink droplets from the plurality of nozzles, the driving unit electrifies the Ta-Si-O ternary alloy thin film resistive element with a series of driving signals comprising one or plural driving pulses.
3. The ink-jet recording head as claimed in claim 2, wherein the driving unit electrifies the Ta-Si-O ternary alloy thin film resistive element with a series of driving

signals comprising a pre-pulse and a main pulse, in which the pre-pulse is for preliminary heating the ink with the Ta-Si-O ternary alloy thin film resistive element with heat energy of such an extent that no bubble is formed, and the main pulse is for heating the ink with the Ta-Si-O ternary alloy thin film resistive element to form a bubble in the ink thus preliminary heated, and a number of the pre-pulse is changed depending on a temperature of the substrate.

4. The ink-jet recording head as claimed in claim 3, wherein time widths of the pre-pulses with which the Ta-Si-O ternary alloy thin film resistive element is electrified are equalized, and electrification intervals of the pre-pulse and the main pulse constituting the series of driving signals are equalized when the ink in the individual flow channels is ejected by the driving unit as an ink droplet from the nozzles.

5. The ink-jet recording head as claimed in claim 1, wherein an electrode for electrifying the Ta-Si-O ternary alloy thin film resistive element is provided on the substrate, and the electrode is covered with the Ta-Si-O ternary alloy thin film resistive element.

6. The ink-jet recording head as claimed in claim 1, wherein a plane shape of an ink contact surface of the Ta-Si-O ternary alloy thin film resistive element is a substantially square shape.

7. The ink-jet recording head as claimed in claim 6, wherein a diameter of the nozzle, a nozzle length from an inlet to an outlet of the nozzle, and a distance from the ink contact surface of the Ta-Si-O ternary alloy thin film resistive element to the inlet of the nozzle are substantially equal to about 1/2 of a length of one edge of the ink contact surface.

8. The ink-jet recording head as claimed in claim 7, wherein the ink contact

surface has an area within a range of from 500 to 1,800 μm^2 .

9. The ink-jet recording head as claimed in claim 7, wherein the ink in the individual flow channel is heated with the Ta-Si-O ternary alloy thin film resistive element so that the ink droplet thus ejected from the nozzle has a volume of from 2 to 16 pL.

10. The ink-jet recording head as claimed in claim 8, wherein the plurality of nozzles are arranged in an arranging direction thereof perpendicular to a head moving direction, which is a direction along which the ink-jet recording head is moved upon recording on a recording material, and a pitch of the plurality of nozzles along the arranging direction is a length corresponding to a resolution of from 800 to 1,600 dpi.

11. An ink-jet recording apparatus comprising:

an ink-jet recording head comprising:

a plurality of nozzles for ejecting an ink;

a plurality of individual flow channels filled with the ink and connected to the plurality of nozzles;

a substrate constituting a part of an inner wall of the plurality of individual flow channels;

a Ta-Si-O ternary alloy thin film resistive element which is provided on the substrate to be disposed in the vicinity of the plurality of nozzles in the plurality of individual flow channels and has a self-oxide film at least on a surface in contact with the ink; and

a driving unit that generates heat energy for ejecting the ink from the plurality of nozzles with the Ta-Si-O ternary alloy thin film resistive element by applying electricity on the Ta-Si-O ternary alloy thin film resistive element,

wherein the ink filled in the plurality of individual flow channels in the vicinity of the plurality of nozzles is ejected as ink droplets from the plurality of nozzles through expansion of bubbles formed in the ink with heat energy from the Ta-Si-O ternary alloy thin film resistive element, and the bubbles formed in the plurality of individual flow channels are connected to atmospheric air through the plurality of nozzles, and

wherein the plurality of nozzles are arranged in an arranging direction thereof perpendicular to a head moving direction, which is a direction along which the ink-jet recording head is moved upon recording on a recording material; and a pitch of the plurality of nozzles along the arranging direction is a length corresponding to a resolution of from 800 to 1,600 dpi; the ink-jet recording apparatus also comprising:

a head driving unit that drives the ink-jet recording head along a head moving direction; and

a conveying unit that conveys a recording material along the arranging direction of the plurality of nozzles relative to the ink-jet recording head.